

Missouri Resources Magazine

Winter 99-00

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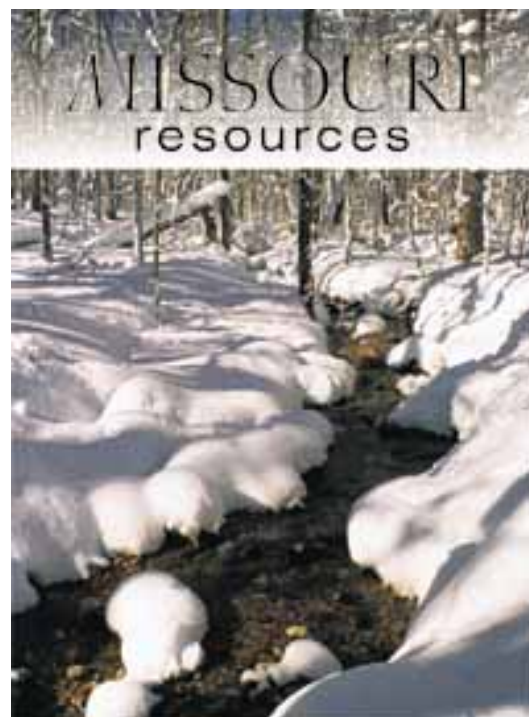


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FRONT COVER: A small creek carves its way through heavy snowfall in Miller County.

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Comments from the Director:

People everywhere have mixed emotions about the upcoming new year. On one hand, there is excitement of witnessing the coming of a new millennium. On the other, there is anxiety that the transition may cause some disruptions in our daily lives.

Will those things that you depend heavily upon like telephones, computers, automobiles, cable, mobile phones and electricity hold up during the change? What about things that affect our sustenance and allow us to have water for drinking, bathing and cooking. Or what about other systems like computer-operated wastewater treatment systems, environmental monitoring equipment or anything else with a time and date function?



The state's Web site has information about steps that each agency has taken to ensure that the services they offer to Missourians will be uninterrupted.

Within DNR specifically, our mainframe Y2K project has been 100 percent complete since June 1, 1999. Our computer staff has been trained to ensure critical systems continue to function well into the new millennium. This will help us ensure that the public has safe drinking water supplies and properly permitted and operated wastewater treatment facilities.

Externally, our staff has worked closely with drinking water and wastewater facility operators to help them become Y2K compliant. Very large water systems in Missouri that have extensive automation and computer assisted controls have already made Y2K changes or upgrades as needed.

These systems also will have staff on board in the early morning hours of Jan. 1 to take action, if necessary, to avert problems.

Smaller operations, which include most of the state's systems, have few controls or other equipment that are data dependent and usually have manual controls that can be operated if their computerized functions fail. We have also offered support and guidance on Y2K issues to the state's wastewater treatment facilities.

In addition to drinking water and wastewater facilities, divisions throughout the agency have worked hard to prepare themselves for Y2K. Our divisions of Environmental Quality, State Parks, Administrative Support, Geology and Land Survey and Energy Center have utilized six steps adopted from EPA that have helped prepare Missourians for potential millennium computer glitches.

Most people do not think about environmental protection until the thing that is protecting them fails to function properly. DNR employees not only have thought about those systems, but we have focused much time and energy

toward ensuring that they work.

I take comfort in the belief that we all will go the extra mile and step up to the plate when called. Preparing for the Year 2000 and its effect on our environment is that type of situation.

A handwritten signature in black ink, reading "Steve Mahfood". The signature is written in a cursive, flowing style with a large initial "S" and a prominent "M".

Steve Mahfood
Director, Missouri Department of Natural Resources

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Current Technology **The Rediscovered Fuel Cell**

by Jim Muench and Sam Orr

When it comes to technology, sometimes what goes around, comes around. Fuel cells, invented before the Civil War and refined by the U.S. space program, just might provide the answer to the world's quest for a non-polluting power source.

A fuel cell is a device that converts chemical energy into electrical energy without using combustion and without creating the pollutants caused by fossil-fuel technologies. Fuel cells can be designed to convert to electricity any hydrogen-based fuel, such as gasoline, methane, methanol or ethanol. If pure hydrogen is used, the by-product is water.

"I envision that fuel cells will revolutionize the way we think about electricity because they promise to make it much easier to generate power on-site with no harmful emissions from their operation," said Anita Randolph, director of the Missouri Department of Natural Resources' Energy Center. "They are an efficient, practical advancement that can lessen our reliance on the fossil-fuel technologies of the previous century."

At present, fuel cells are most visible in prototype cars being developed by the major auto manufacturers. Vehicles powered by fuel cells could be 50 percent more fuel-efficient than conventional gasoline engines while producing no harmful emissions.

"We're planning to have fuel-cell vehicles available to the public in 2004," said Ann Smith, communications manager for advanced technology at Daimler-Chrysler. "We're very encouraged by the technology, but there are still some problems to be worked out."

Smith said Daimler-Chrysler's car will debut at a price comparable to that of a standard vehicle. Meanwhile, engineers have shrunk the technology so that what fit on a full-size van in 1994 now fits in a five-passenger hatchback. Chrysler's model has a range of about 280 miles, nearly four times greater than that of an electric vehicle and comparable to many gasoline automobiles.



Daimler-Chrysler's NE (no emissions) CAR 4 has a range of 280 miles, about four times that of an electric car. The vehicles are scheduled to be available to the public in four years.

Ballard Power Systems, a Canadian company now demonstrating fuel-cell buses in Chicago and Vancouver, expects to commercialize its technology in 2002, according to spokesperson Debby Harris. "Wherever you think of, where you need power today, you can use a fuel cell," she said. "It's an enabling technology, like a microprocessor."

Although the cars receive the most attention, a major use for fuel cells lies in providing on-site, or distributed, power for commercial buildings or dwellings.

Experts from various fields say fuel cells will revolutionize electric power because we will no longer have to rely solely on centralized power plants.

"The understanding is slowly building that distributed generation is a good thing," said Rhett Ross, director of development for the Breakthrough Technologies Institute in Washington, D.C. Breakthrough Technologies is a non-profit educational organization that promotes, among other technologies, the use of fuel cells.

In remote locations such as farms, fuel cells could become the generator of choice, perhaps even allowing farmers to make extra money selling power to their local electric cooperative. The production of hydrogen-rich renewable fuels from sustainably grown crops holds great promise for our economy and environment.

Fuel cells can be stacked or bundled to create small power plants to replace today's monoliths. For instance, a number of smaller fuel-cell plants being developed by companies such as Siemens Westinghouse Power Corp., each producing no more than 10 megawatts of power, could generate power closer to the customer and could back each other up as needed.

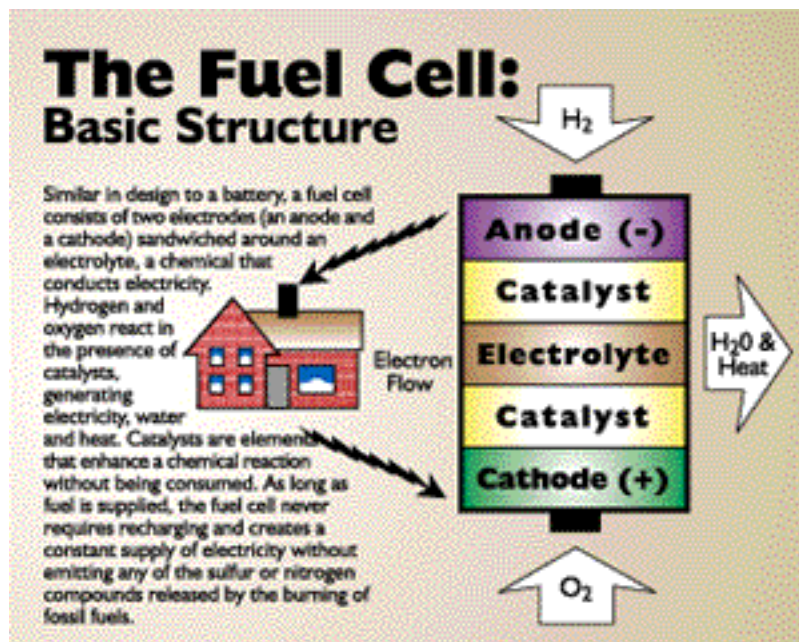
"We are anticipating at around 2003 to be out of the testing stage, with fuel cells offered world-wide as a commercial power source," said Mike Asquino, spokesman for Siemens Westinghouse. "The new fuel-cell power market should develop over time, but it depends on how cost-competitive it is. If people are willing to pay the extra money for green power, then it will take off." At present, fuel-cell power plants cost about \$3,000 per kilowatt, a figure that needs to be halved before people will buy them, according to the Breakthrough Technologies Institute.

Invented in 1839 by Sir William Grove, a fuel cell is similar to a battery, with electrodes on each end. Inside the cell, a substance that conducts electric current (an electrolyte) is sandwiched between two catalysts. When a hydrogen atom enters the fuel cell, the catalysts separate the hydrogen nucleus from its electron and emit the electron as electricity.

There are five basic types of fuel cells, differentiated by the electrolyte used. The first is the alkali fuel cell, which offers 70 percent efficiency and powers the space shuttle. The second is the proton exchange membrane (PEM) fuel cell, which uses a solid polymer between platinum catalysts. Two other types, the phosphoric acid and molten carbonate fuel cells, use liquids, and the fifth type, the solid oxide fuel cell, uses a hard ceramic material.

At the University of Missouri-Rolla, Dr. Harlan Anderson works with solid oxide fuel cells, the type being used by Siemens Westinghouse Corp. and Delphi Automotive Systems. Anderson's Federal Energy Technology Center at UMR has received more than \$1 million from the U.S. Department of Energy over the past 10 years. They hope to reduce fuel cell operating temperatures and increase their efficiency.

"PEM is the near-term solution, while solid oxide is the fuel cell of the future," Anderson said. "PEM has problems with fuels other than hydrogen. Solid oxide has the advantage of the ability to use multiple fuels and can convert hydrogen on-site. You can carry the fuel right on board."



Fuel cells also can be used to make other technologies more efficient and environmentally friendly. For instance, DNR's Energy Center and the Southeast Regional Biomass Energy Program have provided \$25,000 to an ethanol plant in York, Neb., to develop technology that will soon prove useful in Missouri. At the time funds were available for the project, there were no ethanol plants operating in Missouri.

York's High Plains Energy plant wants to double its ethanol output without doubling its waste, thereby avoiding expansion of the town's wastewater treatment plant. The company plans to install an anaerobic digester that will transform leftover organic materials in its wastewater into carbon dioxide and methane, which will be collected, cleaned and converted by a fuel cell into electric energy and heat for the ethanol production process. A soon-to-be-released feasibility study conducted by Fuel Cell Energy Inc. projects that the system will cut costs to less than \$1 per million BTU - less than half the cost of natural gas.

For environmentalists, perhaps the most attractive scenario to which fuel cells may lead is an economy based on hydrogen instead of fossil fuels. Power producers could use solar or wind energy to split water into oxygen



Brian Gorman, a graduate research assistant at UMR, works at developing technology to improve the ways fuel cells are made and operated.

and hydrogen, which could power the fuel cells.

Several oil companies are working with automotive manufacturers to explore the use of hydrogen as a fuel, and Royal Dutch / Shell has joined a consortium to develop a model hydrogen economy in Iceland. This may provide the answer to finite fossil-fuel supplies if demand for cars continues to rise in developing countries.

"At some point, pressures are going to build, and then you could see us going to something like a hydrogen economy," Ross said. "We actually went from a hydrogen economy to an oil-and-gas economy around the turn of the century, when we stopped using what was known as 'town gas' from mines and coal gasification." Hydrogen-rich methane was the main component of town gas.

Mark Twain once said that there is no such thing as a new idea. We simply put old ideas into a mental kaleidoscope, give them a turn and view the curious combinations. With all their economic and environmental benefits, fuel cells may be the most influential recycled idea we will see for quite some time.

Jim Muench is division information officer and Sam Orr is a renewable energy planner with DNR's Energy Center.

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Caulk Talk Small Investment Seals Up Big Savings

Caulking is an easy, energy-saving project you can do yourself. It is relatively inexpensive - yet very effective.

Caulk is a compound used for filling cracks, holes, crevices and joints on both the inside and outside of your home. A minimum of skill is required, and the only tools required are an inexpensive caulking gun, a putty knife and plastic smoothing tool which costs less than a buck. Start at the back of your house and work toward the front so that your skill level is improved by the time you caulk places that are most visible.

Choose a mild day to tackle this project - the temperature should be above 40 F. Old, cracked caulk should be removed before new is applied.

Where to Caulk

Through the years, cracks develop between building materials. Because these cracks allow air infiltration, they should be caulked.

On the interior of your home, you can check for air leakage by moving your hand around the windows and doors on a windy day.

The following areas should be checked:

- Around door and window frames - inside and out
- Places where brick and wood siding meet
- Joints between the chimney and siding
- Between the foundation and walls
- Around mail chutes
- Around electrical and gas service entrances, cable TV and phone lines, and outdoor water faucets
- Where dryer vents pass through walls
- Cracks in bricks, siding, stucco and foundation
- Around air conditioners
- Around vents and fans
- Wherever two different materials meet

The material used in sealing air leaks depends on the size of the gaps and where they are located. Caulk is best for cracks and gaps less than 1/4" wide.

Source: DNR Energy Center

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Eye in the Earth Lights! Camera! Action!

*by H. Dwight Weaver
photos by Nick Decker*

The television screen fades to a black-and-white view that gives you the sensation of falling into the earth. These are moving images but not the camera work of a film director on location making an action movie. These are underground scenes shot on location by a crew of technicians who have no script, no cast of stars and who produce mostly silent films in black-and-white format.

Their stage is the vertical "borehole" of a water well, and their lens is on the end of a "downhole" camera used in the inspection of water wells and other holes drilled for various purposes.

The downhole camera equipment, called a "television inspection system" by manufacturers, is used almost daily by the Missouri Department of Natural Resources' Wellhead Protection Section in the department's Geological Survey and Resource Assessment Division (GSRAD). The section is responsible for issuing operating permits to well drillers and pump installers and ensuring that all domestic water wells, heat pump systems, monitoring wells and mineral exploration test holes are properly installed in accordance with the 1985 Water Well Drillers Act.



"The downhole camera has become indispensable to our work," said Bruce Netzler, chief of the Wellhead Protection Section. "Before we had this technology the only tool at our disposal for physically checking well construction problems was dye tracing on the outside of the well casing. When you look down into the average six-inch-wide domestic water well hole you can only see a couple of feet," said Netzler. "The downhole camera has revolutionized our abilities to diagnose construction and contamination problems with water wells."

A "downhole camera" is lowered into a piece of well-casing pipe, simulating the beginning of its deep, fact-finding journey.

Although the camera device used by the Wellhead Protection Section (Wellhead) is small and

looks fairly simple, it is actually high tech. It is an example of the revolution that has taken place in one area of regulatory technology over the past 10 years; a revolution made possible by the arrival of computers, digital electronics and the miniaturization of electronic equipment.

The need for such equipment has been around for a very long time. The ability to look at the interior of rock layers allows potential environmental problems to be identified more reliably. The discipline is called borehole or well logging.

Today's television and camera survey systems are specialized closed-circuit video systems capable of visually inspecting boreholes as small as two inches in diameter and, depending upon the capability of the camera, to depths of 10,000 feet. An operator lowers the specially designed camera deep into the well to visually examine the conditions inside the borehole. Simultaneously, the inspection is recorded onto a VHS tape as a permanent record. This tape is available for later review.

What do the technicians look for? If the well casing is plastic, they look to see if the lengths have been glued together properly. If the casing is steel, they check details of the welds between lengths of pipe. Any corroded and damaged casing that lets surface water in can be a prime source of contamination. The place where the casing ends and the natural rock begins is a critical area and the camera can help determine if the casing was grouted properly (sealed against the bedrock). The seal between the bedrock and well casing must be completely watertight.

Once the camera eye is below the well casing and is observing the natural rock, geology kicks in and the technicians can see where the groundwater is coming from and examine the structures of the rock itself. The camera also allows them to inspect the drop pipe and other pumping equipment in the well. The camera can even be lowered into a well while the well pump is still in operation.

Paul Meyer of Wellhead uses the camera to measure casing depth, static water level, and total well depth. This information is important for calculating the amount of material needed to plug an abandoned well.

"It is estimated that there are 150,000 abandoned wells and cisterns in Missouri," said Meyer. These wells and cisterns can be very dangerous. Animals, children and even adults can fall into them and drown. Trash and other substances can get into them and contaminate the groundwater, so all abandoned wells and cisterns should be properly plugged.

"Our current downhole camera has a depth limit of 650 feet. That is because our camera cable is only 650 feet long, and because the camera is not designed for the pressures at greater depths. Most of the water wells we examine

range from 200 to 500 feet in depth," Meyer said.

Wellhead purchased its first camera around 1994 and the program currently is looking at upgrading the system by converting to state-of-the-art color video. Black-and-white systems deal with shades of gray, which can be deceptive. Color is now the preferred technology because it clarifies and enhances the inspections of corroded casings, encrusted well screens and mineral deposits.

Cuttings Yield Core Knowledge

A downhole camera is not the only tool available for doing detective work in boreholes. Geologists and technicians at GSRAD also rely upon sample logs and core to provide information about the strata of rock through which water well holes are drilled.

Sample logs, which provide valuable information about water-producing aquifers and rock formations, rely upon cuttings and residue. When a well is drilled, ground-up rock comes to the surface in a slurry of water and driller's mud. The ground-up rock particles are called cuttings.

"We examine the cuttings to determine the texture, color and type of rock the drill bit has penetrated," said Hal Baker, a GSRAD geologist.



The most recent addition to GSRAD's remote-sensing arsenal is this camera mounted on a tractor that is designed to inspect pipes that run through dams and spillways.

Geologists also can learn about the permeability, porosity and composition of aquifers through the study of core samples. Cores are generally solid cylinders of rock that are retrieved when a borehole is drilled with a hollow-core drill. Most well drillers don't produce core but GSRAD has more than 2.5 million feet of core in its McCracken Core Library. The core samples came from more than 2,400 holes that were drilled throughout Missouri over a period of decades.

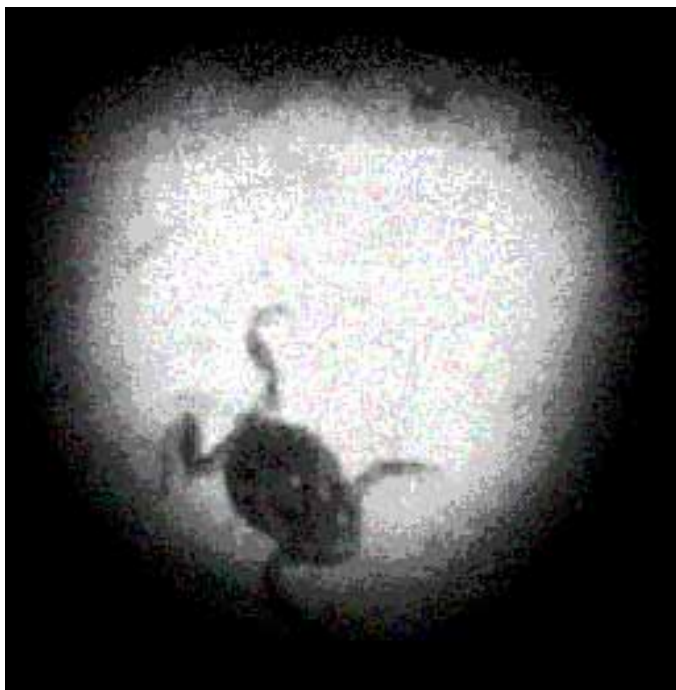
"Studying the core you can get a basic feeling for how the groundwater is moving through a given area," said James H. Williams, director of GSRAD. "This is important because more than two million Missourians rely on groundwater for their drinking water supply."

Most large cities also now have television inspection systems attached to a truckload of high-tech equipment. Applications include drains and conduits, sewer lines, water pipes, gas mains, industrial inspections and search and rescue. One of the more interesting pieces of hardware is the "steerable tractor," which carries lights and camera and looks like a toy truck.

The division's Dam and Reservoir Safety Program has purchased a remote-controlled miniature steerable truck system that will allow them to traverse and inspect the pipes in dams.

The division's Environmental Geology Section also has a need for borehole camera equipment for use in wells designed for monitoring groundwater levels and flow. "The camera can provide information about the fractures in the bedrock, especially in karst areas where sinkholes, caves and springs are present," said Peter Price, a Geology and Land Survey geologist. "We use dye tracing to track the movement of groundwater and contaminants below the surface. Groundwater conduits accessible by monitoring well boreholes can be useful dye-injection locations."

Unfortunately, the Environmental Geology Section is not able to use the same equipment as the Wellhead.



Toads and other small animals were found in this unplugged drill hole. Besides depositing fecal matter, animals that eventually die in wells leave the potential of contamination through decomposition.

technology. Only a few nationwide well-drilling companies then had cameras that could be lowered into wells and the cameras were prohibitively expensive. So, David Hoffman, a division geologist, decided to make his own.

He did so by adapting two cameras from old-style camcorders then being sold at clearance prices. The camcorders were disassembled and the camera portions rewired and placed in a watertight, clear plastic tube along with small light bulbs. The camera tube was controlled by aluminum tubing that went to the surface where the camera wires were attached to a five-inch television monitor. From concept to completion, it took Hoffman two months.

The experimental downhole camera was used almost immediately on the Weldon Spring project near St. Louis. The Nuclear Regulatory Commission (forerunner of the U.S. Department of Energy), and the U.S. Geological Survey were doing groundwater contamination studies at the site.

"I think what we learned helped everybody understand what was there and what wasn't," said Hoffman. "But our downhole camera was very primitive and experimental compared to the sophisticated equipment now being used."

The technicians of the Wellhead Protection Section may not be creating videos that win awards and make millions at the theater box office, but the videos are very popular with well owners and well drillers because they help solve so many problems.

"Wellhead uses their camera in wells intended for drinking water," said Price. "Monitoring wells are used for environmental monitoring applications and are usually located around landfills or hazardous waste sites. These wells may contain contaminated groundwater.

"It is important that Wellhead's camera equipment be kept clean."

"We decontaminate our camera every time we take it out of a well so that the equipment won't contaminate the water in the next well we use it in," said Meyer. "We use a chlorine water solution. Several times a month we also clean the entire unit with soap and water."

The Environmental Geology Section actually was the first group at GSRAD to initiate the use of a downhole camera by making its own in 1987. This was before today's highly miniaturized digital electronic

There is something strangely alien about much of the underground landscape the downhole camera captures in these man-made holes – holes that puncture the skin of the earth and from which we withdraw groundwater. Well holes and DNR's downhole camera give us a window of opportunity to examine the subsurface beneath our feet. The Wellhead Protection Section maintains an educational video that features their "top ten wells." These are wells that demonstrate what can go wrong in a well and capture some of the unexpected things they've seen in wells.

For more information about the downhole camera or concerns you may have about your well, call the [Wellhead Protection Section](mailto:WellheadProtectionSection@dnr.state.mo.us) at (573) 368-2165; or access the DNR web site at [www.dnr.state.mo.us/homednr.htm], then click on geology, land survey, water, then well drilling.

H. Dwight Weaver is division information officer for DNR's Geological Survey and Resource Assessment Division



Peter Price, left, assembles the cumbersome original downhole camera while Bruce Netzler, right, demonstrates the smaller size and portability of the present camera equipment.

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LETTERS

We are planning on building a new earth-type home in a rural Missouri area. Do you have or know where we can get information on solar power systems for a home?

Your time and consideration is greatly appreciated.

Dwayne Staton
Grant City

Editor's note:

The Energy Center, formerly DNR's Division of Energy, has staff available to address solar power system questions through their Residential Unit. They can be reached at (573) 751-3443, or by e-mail at [energy@mail.dnr.state.mo.us].

I have always enjoyed and looked forward to Mr. Mahfood's Director's Comments. *Missouri Resources* Vol. 16, No. 3 (Fall '99) printed his comments in an imperceptible size. Vol. 16, No. 2, and I think all previous issues were a very pleasant, easy reading size. Just because his comments contained a few more words of wisdom, you decided to make them microscopic and didn't even fill the page completely.

Sometimes government employees find a refreshing new way of thinking if they are assigned to the field for a while; doing anything away from headquarters.

Henry Weller
Ava

Editor's note:

Getting out of the office for a while sounds great, but management feels shorter leashes suit me best. The reduced type size was part of our ongoing magazine re-design during 1999, culminating with this issue. We agree that "form follows function" and have enlarged the type accordingly.

As a business person, could I obtain a copy of *Missouri Resources* magazine for our office? I'm sure many of our town's people would love to have access to it. I was in my doctor's office waiting for my appointment and

read the quarterly publication from cover to cover. It's great! I will recycle it and put it in our second office as well in Festus.

Leisa Spiker
Imperial

Enclosed is my card for a subscription for *Missouri Resources*. I have a request, if possible. I visited the old Times Beach, now Route 66 Park, a couple weeks ago. We were residents of the area for 15 years. The park now displays an aerial map that shows all our homes when we lived there.

What I want to know is, do you know where it came from and if I could obtain a copy of it? Any information would be appreciated.

Lena Shipley
Dora

Editor's note:

Route 66 State Park staff tell us that they have had many requests for copies of that photo. Currently, they are trying to determine who took the photograph, and if the original is available to request copies from. Those who have inquired about copies will be notified if they become available, and how much they will cost.

Letters intended for publication should be addressed to "Letters," *Missouri Resources*, P.O. Box 176, Jefferson City, MO 65102-0176 or faxed to (573) 751-7749, attention: "Letters." Please include your name, address and a daytime telephone number. Space may require us to edit your letter. You can e-mail *Missouri Resources* staff at moresdnr@mail.dnr.state.mo.us

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NEWS BRIEFS

Energy Division Changes Name, Reorganizes

As part of a reorganization that began in October, the Department of Natural Resources' Division of Energy has changed its name to the Energy Center to highlight its new customer-based structure.

"We've reorganized our agency to better identify with Missourians' needs, and we wanted a name that reflected our mission as a customer-service agency," said Anita Randolph, director of the center. "An organization's name is a symbol of what it stands for, and we wanted our name to represent our commitment to reach out to the citizens we serve."

Changes recently implemented by the agency include the creation of four units that will deal with customer needs in specific sectors: Schools and Local Governments, State Government, Residential and Business and Industry. The center also plans to add outreach staff in Kansas City and St. Louis and intends to set up an Energy Advisory Council that will provide public input the center can use to better meet the needs of Missouri citizens.

Earth Science Week Celebrated at GSRAD

This year, like last, the second week of October was celebrated nationwide as Earth Science Week. Gov. Carnahan recognized the event in Missouri by signing an official proclamation. The foundation of the proclamation is built on the premise that geology and the earth sciences are fundamental to society and our quality of life.

To celebrate the special week, the department's Geological Survey and Resource Assessment Division (GSRAD) developed an "earth science classroom kit" for middle school teachers. Included in the kit were five large, colorful earth science posters created by the division's public information and graphics staff. The posters explain how geologists, hydrologists, surveyors and engineers at GSRAD do their work and why it is important to Missourians.

During October, staff from the division gave presentations to earth science students at a number of middle schools and the classroom kits were a part of the presentations.

"Today's children will soon be making decisions that influence our lives. They need to understand more about the natural and man-made processes that shape our world," said James H. Williams, state geologist and GSRAD division director.

New Exhibit Features Historic Route 66

A new exhibit that showcases "Route 66: Missouri's Main Street" is now open in the Missouri State Museum in

the state Capitol in Jefferson City.

The exhibit is a cooperative effort between the Missouri Department of Natural Resources, which operates the state museum, and the Route 66 Association of Missouri. The exhibit uses photographs, postcards and artifacts to tell the story of the route that became one of Missouri's most famous highways. The road passed through eight states and this exhibit explores the history of the people and towns along Missouri's portion of Route 66.

The exhibit will be in the Missouri State Museum until Jan. 30, 2000. In February, it will be transferred to Route 66 State Park near Eureka. The state park preserves a portion of the original Route 66.

Improvements Made at State Park Boat Launch

Construction on a major improvement project is under way at Lake of the Ozarks State Park in Camden County. The parking lot of the boat launch area at the park's Grand Glaize Beach area is being expanded to accommodate more users and redesigned so traffic flows more efficiently and congestion is decreased. The number of parking spaces will be expanded from 125 to 232.

To allow boat launching during the late winter and early spring while the existing ramp is closed, another boat ramp is being developed in the adjoining cove. The interim three-lane boat ramp and a 135-space parking area should be developed by Feb. 1, 2000. The existing area that is being expanded should reopen by spring of 2000.

The expansion is being made following requests by the general public and by fisherman who need the ramp and parking area during tournaments.

Input Sought on Impaired Waters

DNR is seeking public input on its Year 2000 list of Missouri's impaired streams and lakes. Citizens are invited to review the 1998 list and possible changes, as well as the strategy for water protection and cleanup. These include proposed additions and deletions to the 1998 documents that would craft the Year 2000 list and strategy. The list, required by Section 303(d) of the Federal Clean Water Act, establishes priorities for stream and lake protection and cleanup. DNR will accept public comments through Jan. 19, 2000. The information is available by request or on DNR's Web site at [www.dnr.state.mo.us/deq/wpcp/wpc-tmdl.htm].

On Jan. 19, 2000, DNR will conduct a formal public hearing on the streams and lakes recommended for the year 2000 list at the Missouri Clean Water Commission meeting, Capitol Plaza Hotel, 415 W. McCarty St., Jefferson City. A second public comment period will remain open through March 3, 2000. On March 15, 2000, the Clean Water Commission will be asked to approve this final proposed list for submittal to the U.S. EPA.

Citizens can provide written comments to DNR, Water Pollution Control Program, P.O. Box 176, Jefferson City, MO 65102-0176. For more information, call 1-800-361-4827 or (573) 751-1300.

NRC Elects EIARA Staffer to Board

On Sept. 29, Kenneth Seeney, assistant for planning and public affairs for the Environmental Improvement and Energy Resources Authority (EIARA), was elected to the board of directors for the National Recycling Coalition (NRC). The election was held during NRC's annual Congress in Cincinnati.

The EIERA provides technical and financial assistance for energy and environmental projects.

Seeney was elected to a two-year term and was also elected to the NRC's Executive Committee by fellow board members. He attended his first Congress in 1990 and has been very active in the NRC since that time. Currently, he is co-chair of NRC's Diversity Committee and treasurer of the Minorities Recycling Council. Last year, he served on the Slate Selection Committee and in 1994-95 served on the Host Committee for the 1995 Congress, which was held in Kansas City.

The NRC is the nation's largest organization devoted to recycling and waste reduction issues. Based in Alexandria, Virginia, the NRC conducts programs and publishes information on effective recycling and source reduction practices, market development, and purchasing recycled-content products. The NRC has 35 affiliates nationwide, including the Missouri Recycling Association.

For a complete listing of DNR news releases, please access our Web site at [[/newsrel/](#)].

DNR presented the fuel summit information to Gov. Carnahan, who signed the law in July.

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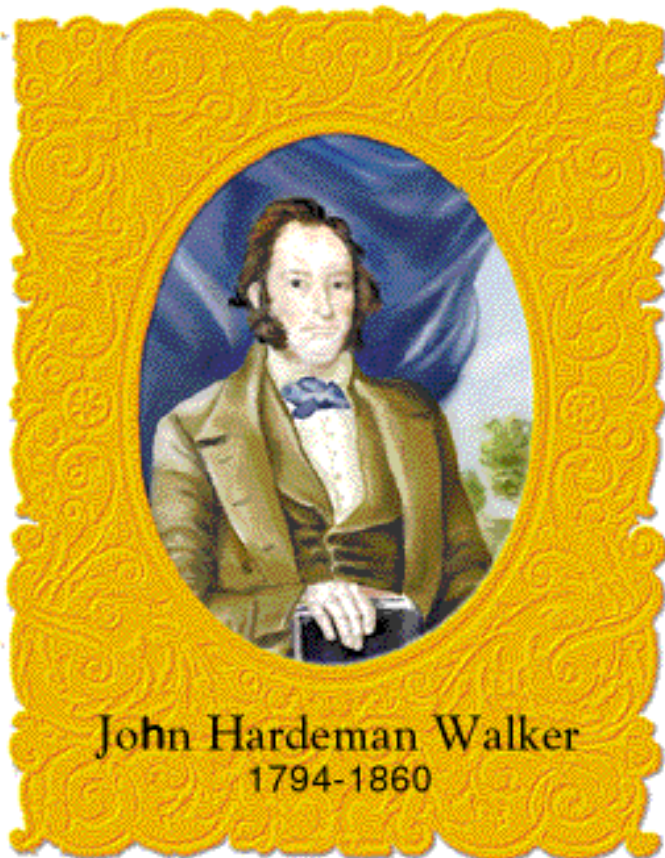
ONE LAST WORD

Bootheel Politics, Frontier Style

by H. Dwight Weaver

Legend has it that when the first violent shaking of the 1811-1812 earthquake occurred in southeast Missouri, John Hardeman Walker, a 17-year-old settler of the area, fell to his knees and prayed. His hunting companion, who knew him well, looked down and said: "Get on your feet, John! Stand like a man! You didn't pray when the earth wasn't shaking and it won't do you any good now!"

There are many legends about John Walker. His story is the tale of the "Heel" or "Bootheel" of Missouri. It is a story of frontier empire building and politics set upon a stage of rivers, swamps, sloughs and bayous when Missouri was just a territory and monumental things were happening in southeast Missouri.



In 1810, when Walker arrived at Little Prairie along the west bank of the Mississippi River, then one of only two settlements in the Bootheel region, he was 16 years old. The town was a community of 24 log cabins and 100 residents about two miles south of what is now Caruthersville. Here, too, was the Spanish fort, St. Fernando, that was established in 1794 by the French-Canadian trapper and trader, Francois LeSieur.

By all accounts, John Walker was a shrewd and ambitious young man who wanted to be a cattle king. When the earthquake occurred he took his friend's advice and did "stand like a man." While the other settlers of the area fled for their lives never to return, John Walker stayed put. Even as frightening aftershocks plagued the region for a year afterwards, Walker persisted. He rounded up all the stray cattle that the fleeing settlers had abandoned and, using rivers and bayous as fences, let the cattle run wild and multiply on the thousands of timbered acres he then claimed. As one early writer put it, "He remained to become the 'Czar of the Valley,' the law of the 'Heel of

Missouri."

But unlike the ranchers of the Great Plains who became famous for their cattle drives in the 1880s John Walker became famous for his "skinning drives." There is an old settlement site on Pemiscot Bayou three miles west of Steele once called "Cow Skin" because of Walker. Each year, Walker would ride into the area and slaughter hundreds of his wild cattle, dry their hides on the banks of the bayou, and then ship the hides to New Orleans.

When Missouri applied for admission to the Union in 1818, the line that was suggested as the south boundary line of the new state did not include what is today Pemiscot and Dunklin counties. This upset Walker because the recommended line was 25 miles north of him. Its adoption would leave him in the unorganized territory of Arkansas and his loyalties were to Missouri and his influential friends in New Madrid.

"He went to work in earnest to prevent his being left outside of an organized state," said Missouri Senator George W. Carleton in 1889. He interviewed the persons selected to define the boundary lines of the state and so eloquently did he and his political friends plead his cause that the territorial legislature agreed to take Walker into the state of Missouri. They extended the southern boundary there to include all the territory between the Mississippi and St. Francis rivers as far south as the 36th parallel. This comprised all of Pemiscot and Dunklin counties, thus giving Missouri its Bootheel.

Walker went on to distinguish himself further. He was the first sheriff of New Madrid County and later elected Presiding Judge of the County Court. Then, in 1857, at age 63, he laid out the city of Caruthersville, the county seat of Pemiscot County. John Hardeman Walker died in 1860 and is buried in the Eastwood Memorial Church cemetery of Caruthersville.

Legend doesn't tell us what John was praying for when the earthquake occurred but his prayer must have been answered because the quake paved his way to wealth and fame and robbed Arkansas of what is today some of the richest farmland on the face of the earth.

H. Dwight Weaver is the division information officer for DNR's Geological Survey and Resource Assessment Division.

Missouri Resources Magazine

Winter 99-00

RESOURCE HONOR ROLL

Bryan Parker, a civil engineer with Elgin Surveying and Engineering, Inc. in Rolla, joined the Missouri Stream Team Program in 1995. He is an experienced volunteer water quality monitor, participates in stream litter pick-ups and has been a presenter at the Rolla Water Festival and the Missouri Rivers & Streams Conference. But one of his biggest environmental contributions to date has been serving as Web Master for the Missouri Stream Team home page.



Bryan Parker

Parker promptly responds to Stream Team staff requests to post information and recently redesigned the site to make it easier to navigate within it. There have been approximately 8,000 visitors to the home page in the past two years. As the program has grown, so has the complexity of the site. Volunteer monitoring data and automated workshop registration forms are recent additions. Parker has spent hundreds of hours performing this service on a strictly volunteer basis. His efforts have resulted in water quality information being readily available to the public, as well as increased participation in Missouri's environmentally critical Stream Team Program.

Parker's hard work on behalf of our environment can be viewed at [www.mostreamteam.org]. Why not pay it a visit and let him know what you think?

Karen Fosse has never been bashful about integrating environmental awareness into subjects like reading, writing and mathematics for elementary students.

As part of the language arts program she taught at Cassville's Jenkins Elementary School, students once wrote letters to President Bush and received replies from the White House concerning harmful fluorocarbons in the air. Throughout her teaching career, this integrated approach to environmental education has earned Fosse and her students state and national awards for composting and recycling, including the acclaimed President's Environmental Youth Award.



Karen Fosse

In 1991, she first linked environmental issues with school subjects. This led to increased student awareness, the self-naming of Fosse's enviro-students as the "Earth Savers" and a 50 percent reduction of school waste. She proved the "Earth Savers" concept could work at other schools. During her two-year tenure as a teacher at White Rock Elementary School in

Jane, Fosse's student "Earth Savers" cut solid waste at the school by more than 25 tons.

When not working as a teacher at Exeter Junior High School, Karen often dresses as a clown in recycled clothing and becomes "Aunt Lulu, Environmental Queen of the Ozarks." As Lulu, she travels across the state to educate and entertain people about the benefits of recycling, alternative energy choices and environmental protection.

Missouri Resources Magazine

Winter 99-00

RESOURCES TO EXPLORE

First Missouri State Capitol State Historic Site

By David Klostermeier



The buildings that comprise First Missouri State Capitol State Historic Site highlight St. Charles' historic district.
DNR photo by Nick Decker

In 1820, the population of the Missouri Territory was around 67,000. Missouri was evolving from a territory into a state and needed a meeting place spacious enough to hold a legislative body. This was a problem as large rooms were hard to find because most buildings on the frontier were small. The territorial government had met in various available rooms in St. Louis, mostly in the Mansion House Hotel.

Missouri's population was first concentrated on its eastern borders along the Mississippi River. Then, just before statehood, new immigrants increased the population in the center of the state along the Missouri River. They demanded a central location for the state's capital. Article Ten of the Missouri Constitution was written to declare that the state capital should be located in the middle of the state within 40 miles of the mouth of the Osage River as it flowed into the Missouri River. No other state's constitution proclaims the location of its capital. St. Louis citizens were outraged.

While the federal government was deciding to accept Missouri's state constitution, the soon-to-be 24th state needed to find meeting rooms large enough to assemble its government, while a permanent state Capitol building could be built in central Missouri. Towns competing to be the site of the temporary state capital were Potosi, Cote Sans Dessein, St. Louis, St.

Charles, Franklin, Florissant, Boonville, Ste. Genevieve, Herculaneum and Newport. The citizens of St. Charles offered to pay the rent if their city could serve as the temporary site. The state accepted and on Nov. 25, 1820, Missouri's first governor, Alexander McNair, signed a bill making St. Charles the capital.

The rooms used for the first state

Capitol were located on the second floor in two newly constructed adjoining federal-style brick buildings. The structures were owned by merchants, Charles and Ruloff Peck, and by a craftsman named Chauncy Shepard. The upstairs rooms owned by the Pecks were converted for the Senate and House chambers.

Missourians had voted for their first state officials in August 1820. Along with electing McNair as governor, they elected 43 representatives and 14 state senators. They comprised Missouri's first general assembly.

The elected state officials chose David Barton and Thomas Hart Benton for U.S. senators, while John Scott was selected as Missouri's only congressional representative.



Fourth grade students from Central Elementary School in St. Charles learn about Missouri history in the state's original legislative chambers.

Missouri wanted to enter the union as a slave state. Maine was allowed to enter at the same time as a free state to maintain an equal balance of power in congress. This negotiation was called "The Missouri Compromise." However, when Missouri submitted its constitution, it was denied statehood because of a clause that would " ... prevent free Negroes and mulattos from coming to and settling, in this state, under any pretext whatsoever." The free states believed this clause violated the federal constitution because it restricted the free movement of U.S. citizens, even though the U.S. Supreme Court still had not ruled if African-Americans were citizens. Missouri's decision to nullify this clause from its constitution was called "The Second Missouri Compromise." Twenty-four years later, in 1844, Missourians would again ban free African-Americans from entering the state.

It was in St. Charles that Missouri officials met in an emergency session on June 4, 1821, to draft a response nullifying the clause in the state's constitution that was preventing federal recognition of Missouri's statehood. Once this draft was submitted, President James Monroe proclaimed Missouri a state on Aug. 10, 1821. Therefore, St. Charles can be considered the site of Missouri's last territorial Capitol and its first state Capitol.

As the business of being a state began, most hand-written documents were written with quill ink pens. Feathers from geese, turkeys or crows were trimmed into pens. Literate legislators and the clerks and secretaries carried small knives (hence penknives) to cut new points on pens as they became dull or broke. Small scissors also could be used. Metal-tipped pens were available but expensive. Ink could be purchased in St. Charles in the 1820s, but many people preferred to make their own from boiled walnut hulls, water, vinegar and salt. Soot sometimes was added to make the ink blacker.

Missouri's first elected legislators



The St. Charles Fife and Drum Corps performs at Statehood Day, one of several special events held annually at First Missouri State Capitol State Historic Site.
Photo by David Klostermeier

Jefferson City.

The buildings used as the first Capitol remained in private ownership until the 1960s. Starting in the early 1900s, the buildings and surrounding area gradually deteriorated. The buildings that now make up the First Missouri State Capitol State Historic Site were acquired in 1960 by the state of Missouri through then-Governor James T. Blair. His efforts were prompted by concerned citizens of St. Charles who recognized the value of the buildings.

The acquisition and restoration of the first state Capitol buildings by the state of Missouri became the starting point of a national historic district that has revitalized an economically depressed portion of St. Charles.

Missouri is one of the few states to retain its original first state Capitol structure. After ten years of research, fund raising, preservation, archaeology, restoration and reconstruction, First Missouri State Capitol State Historic Site opened in time for Missouri's sesquicentennial in 1971.

Today, it is much easier for a visitor to travel to the state's first Capitol than it was for early legislators. Located at 200-216 South Main Street in St. Charles, just a mile north of Interstate 70, First Missouri State Capitol State Historic Site is surrounded by a thriving historic district. Shops, restaurants and other historic attractions, many housed in original 18th and 19th century buildings draw visitors with a

were from various backgrounds ranging from educated lawyers to illiterate farmers and hunters. Most had a strong dedication to public service. An example of a dedicated politician of the times was Simon Cockrell. Cockrell was elected to the state legislature when Clay County was formed in 1822. He was 80 years old when elected and traveled on horseback nearly 300 miles across Missouri wilderness to St. Charles, many times in the winter.

After Missouri became a state, the legislators met for the next session from November 1821 to January 1822. It was during this time that the great state seal was created. They continued to meet in sessions in St. Charles until Oct. 1, 1826. Then, state documents and Capitol furnishings were relocated by boat to the new state Capitol in

taste for Missouri history. The historic site's interpretive center has two floors of exhibits and a 23-minute orientation show. Admission is free to the interpretive center. Entrance to the Capitol buildings is by paid guided tour.

The tour takes visitors through the actual rooms where Missouri state government was created and first practiced. Antique furnishings are the type used during the 1820 occupation. The Peck Dry Goods store has examples of merchandise needed in the 1820s, with furs on display to show visitors the importance of the thriving fur trade. A "Video Tour of First Missouri State Capitol" is available in the interpretive center to those who cannot climb the stairs to gain access to the second story legislative chambers. The site is a traditional field trip destination for Missouri school children.

First Missouri State Capitol State Historic Site hosts four annual special events each year. The first is "A Salute to Missouri's Black History" held the last Saturday in February. This event is hosted in cooperation with the St. Charles County Historical Society in celebration of Black History Month.

The second event is the Missouri Statehood Day Celebration. Held the closest weekend day to Aug. 10, Statehood Day celebrates Missouri's birth into statehood. Featured are period crafts, historically dressed reenactors, a free open house, and "Missouri birthday cake."

The popular Historical Children's Festival is the third annual event. Held in September, activities include historical toys and games, doll making, quill-pen writing, butter churning, candle dipping, a fur exhibit, storytelling and more.

The year concludes with the Candlelight Concert Series, held on Saturday evenings in December. Excellent acoustics in the original House of Representatives chambers provide great traditional music listening during the holiday season.

The Missouri Department of Natural Resources operates the First Missouri State Capitol State Historic Site as part of the state park system. For more information, call the site at (636) 940-3322 or the department toll free at 1-800-334-6946 or 1-800-379-2419 with a Telecommunications Device for the Deaf (TDD).

David Klostermeier is the site administrator at First Missouri State Capitol State Historic Site within DNR's Division of State Parks.

Missouri Resources Magazine

Winter 99-00

TEACHER'S NOTEBOOK

"Deal of the Century"

by Dwight Weaver

The Missouri Department of Natural Resources' Geological Survey and Resource Assessment Division (GSRAD) is doing something new and unusual for a state agency - producing [trading cards](#).

"As far as we know, we are the only state natural resource agency in the United States that produces trading cards as an annual series to focus the attention of kids and young adults on natural resources," said James H. Williams, state geologist and director of GSRAD.

"The division has a lot of information about caves, springs, rivers, rocks, minerals, fossils, geologic wonders, ice age animals, wells, dams and land surveying that people are interested in. For some time the division looked for a way to produce educational materials that people could have fun with and still find educational.

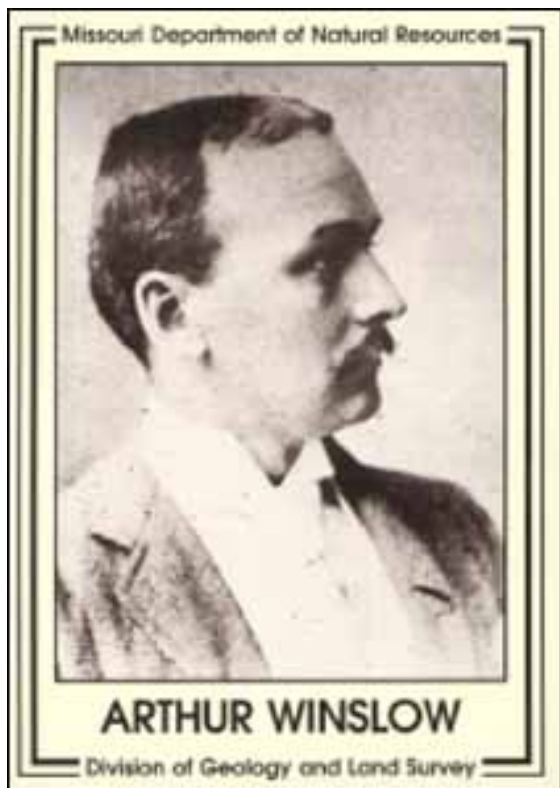
"We especially wanted to reach children because they have an unquenchable curiosity about these subjects," Williams added. "In 1997 our public information staff came up with the idea of EAOping into the popularity of trading cards. Kids and collectors love them. The Missouri Resource Trading Cards have turned out to be a very successful project for us."

Trading cards have been around since the 1860s when Louis Prang issued cards with popular Civil War generals on them. They were an instant success. Baseball cards came along in the 1880s. Non-sport trading cards are also common and are issued by many different companies. Nature subjects are popular. Even the National Geographic has issued trading cards.

"The Missouri Resource Trading Cards have become one of our hottest sellers," said Terry Sheffield of the GSRAD maps and publications service. "In 1998, we produced 1,000 sets of our first series, which contained 40 different cards. We weren't sure how popular they would be but once the word got out, orders came in so



FOSSILS - This five-card set features outstanding photos of Missouri fossils, including crinoids, brachiopods, trilobites, bryozoans and ammonoids



fast we could hardly keep up with them. We plan to continue producing a new series each year and premiering them each year at the Missouri State Fair."

Elementary school teachers also have discovered the cards and find them educational because they "focus on the kinds of things that kids love to learn about," said Lynn Bextermueller, a teacher in the Francis Howell School District of St. Charles County. "I definitely would suggest them for use in conjunction with our Missouri studies in the fourth grade."

For many years, DNR's Environmental Assistance Office (EAO) has provided environmental education courses for teachers. "The courses that feature caves, springs and geology have consistently been popular," said Steve Schneider of EAO. "The Missouri Resource Trading Cards are excellent tools for the teachers who take our courses because of the subjects the cards cover. The cards can help teachers enhance student proficiency in the knowledge, skills and competencies listed in the Show-Me (educational) Standards."

STATE GEOLOGISTS - This topic continues the history of the Geological Survey and Resource Assessment Division as seen through the stories of the different men who have served as Missouri's official State Geologists. The Survey has been in existence since 1853.

Activities

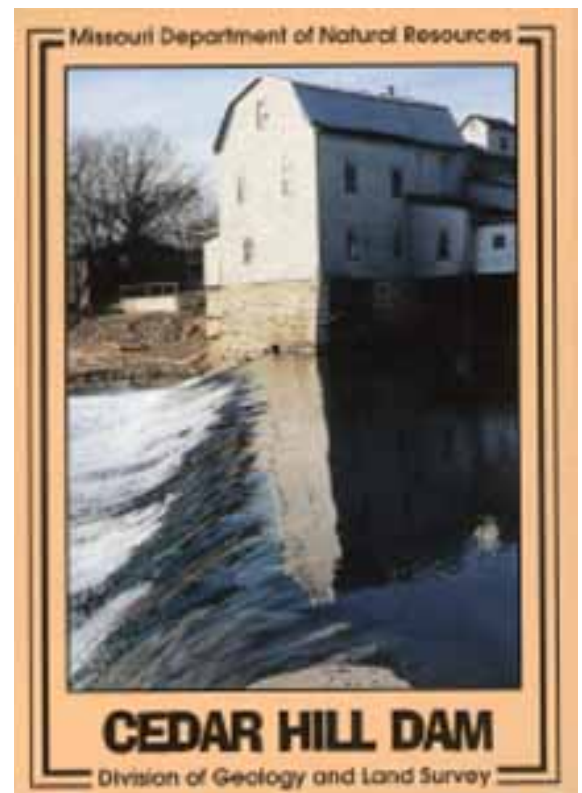
Each set of Missouri Resource Trading Cards comes with a game sheet that tells how the cards can be used for playing ordinary games as well as educational games. Games titled Quick Suits, Solitaire and True or False are described for the average card owner. For teachers and students, there are educational games like Trader's Guess, Tough

Trader and Trader's Challenge.

The various suits, which are topic specific, are color-coded. Educational games can be played with the full deck or specific topics. Most of the classroom games are best played with a specific topic, for instance, fossils. They can be made very interactive and challenging by combining the text on the backs of the cards with the imaginations and skills of both the teachers and their students.

The new 2000 series of Missouri Resource Trading Cards are available for \$8 a pack, postage paid; and the 1998 series is still available for \$6 a pack. For your convenience, this issue of Missouri Resources will include an order form next to the magazine subscription card. Order one or both sets by calling (573) 368-2125; by faxing (573) 368-2111; or by e-mailing DNR's Geological Survey and Resource Assessment Division at GSRADpubs@mail.dnr.state.mo.us].

H. Dwight Weaver is division information officer for DNR's Geological Survey and Resource Assessment Division.



DAMS - Four different dams are featured. They include Cedar Hill Dam, where a controversy in 1847 led to the first dam legislation in the state, as well as Table Rock Dam, which creates one of largest recreational lakes in the Missouri Ozarks.

Other Missouri Resource 2000 Series Trading Card categories are: Caves, Ice Age, Land Surveying, Rocks and Minerals, Wells, Missouri Geology, Rivers, Geologic Wonders, Springs, and Publications.

Missouri Resources Magazine

The State of Missouri's Environment First-time report outlines conditions, concerns

*by Earl Pabst and Connie S. Patterson
photographs by Nick Decker*



Almost 5.5 million people call Missouri home. The Missouri Department of Natural Resources (DNR) works to assure that the environment is protected for every one of them.

"The department was formed in 1974, when there were fewer environmental protection laws on the books," said DNR Director Steve Mahfood. "Today, just over 25 years later, there are laws protecting the quality of the water you drink, the air you breathe and the land you use."

And, today's environmental protection efforts are hitting closer to home for many people. "Missouri citizens are going a step further by getting personally involved in natural resource protection," said John Young, director of DNR's Division of Environmental Quality. "They are helping us help them protect their natural resources. We have more than 23,000 Stream Team volunteers and nearly 6,600 agricultural land owners placing conservation practices on their land."

DNR approaches environmental protection as a big picture, according to Mahfood. "We're studying the water, air and land in each watershed as a total system. That way, we use more and more information to learn how everything we do is woven together," he said. "We are crossing traditional environmental protection boundaries as we look at how pollution affects the water, air and land."

In keeping with this big-picture approach, DNR recently published Missouri's first report on the state of its environment. "This report is a measure of environmental trends," said Young. "We call these measures environmental indicators because they indicate how we're progressing on protecting and improving our water, air and land."

Indicators are a broad approach to determining if Missouri's natural resources are in better condition today than they were a few years ago. Are the number of stream miles meeting water quality standards increasing or

decreasing? Is the air you are breathing today cleaner than it was 10 years ago? Is soil erosion in Missouri increasing or decreasing; are we saving our valuable topsoil or not?

Where we are today determines where we are heading tomorrow. So, just where are we today?

Water Quality

The 1998 Missouri Water Quality Report identified stream segments that did not meet water-quality standards. The stream segments are ranked based on the pollution severity and designated uses of the waters.

A little more than 10,000 miles of Missouri's 21,978 permanent stream miles are not fully meeting water quality standards. Chemicals harm approximately 200 of those miles, and the remaining 9,993 miles are affected by the physical condition of the stream. Approximately 117,000 acres of Missouri's 292,204 acres of lakes are threatened by eutrophication. Eutrophication is nutrient enrichment of a water body that leads to increased algae growth. 42,660 lake acres are impaired by herbicides or by discharges from upstream dams.

Water pollution sources are generally classified as either point source or nonpoint source. A wastewater treatment plant or an industrial facility that discharges directly into a stream is a point (clearly defined) source. Most point-source dischargers are required to operate under a national pollutant discharge elimination system (NPDES) permit. This permit is issued by DNR and requires that the discharging facility meet specified limits on pollutants going into Missouri rivers and streams.

With nonpoint-source pollution, there is no single known discharge point. Control of nonpoint water pollution sources, such as runoff from farms, cities, mining areas and construction sites, still is essentially a voluntary program.

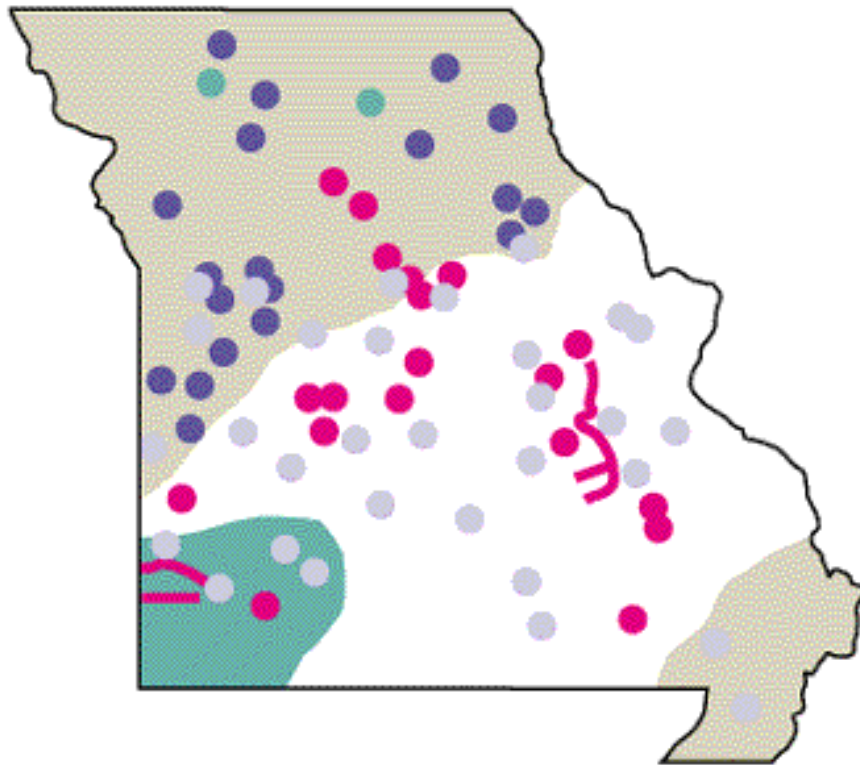
Point-Source Impacts Are Declining

Classified stream miles impaired by point-source wastewater discharges are declining, primarily due to construction of new wastewater treatment facilities. The number of miles of classified streams impaired by point-source wastewater discharges have decreased since 1984. In 1998, 91 miles of streams were impaired.

Nonpoint-Source Pollution Remains Significant

Trends on some of our rivers and recreational waters have shown improving water quality. However, nonpoint-source pollution remains significant.

Missouri's Water Quality



Soil erosion, stream channelization and removal of riparian tree cover have resulted in wider, shallower streams with fewer pools, more heavily eroding streambanks, fine, unstable bottom sediments (silt and sand), higher water temperatures and lower levels of dissolved oxygen.

- Nineteen public drinking water supply reservoirs, serving a total of 54,000 people, have levels of atrazine or cyanazine (two common agricultural herbicides) in excess of water quality standards.
- Thirty-one municipal wastewater plant discharges cause such problems as sludge deposits, excessive algae growth, high levels of ammonia and low dissolved oxygen levels in 42 miles of streams.
- Concentrated animal feeding operations (CAFOs) had massive manure spills that killed fish on 19 miles of streams. In southwest Missouri, many streams have elevated levels of nitrogen and problems with excessive algae growth due to the large amount of animal manure applied in their watersheds.
- A total of 156 miles of stream are adversely affected by lead mining and coal mining.

What is Impaired Water Quality?

In September 1998, DNR submitted a list of impaired stream and lake segments to the U.S. Environmental Protection Agency (EPA). This list, which is required by Section 30360 of the federal Clean Water Act, contained 173 segments. EPA added an additional five stream segments and approved the list.

DNR currently is planning how to implement solutions to the water quality problems of these high-priority streams and lakes. These plans, referred to as total maximum daily loads, will be developed for each of Missouri's impaired waters. The total maximum daily load establishes limits on specific contaminants to restore the water and to meet water quality standards.

Looking Ahead

In 1999, the Missouri legislature approved additional resources for the department to protect Missouri's water-quality-impaired waters. Work will include sampling at new monitoring sites, providing training and assistance for municipal facility owners and offering technical and financial assistance to the nonpoint source and agricultural communities as needed.

We are making progress on protecting Missouri's water quality, but concerns remain. The straightening of streams, the impact of large concentrated animal feeding operations, mining and increased nutrient loading (eutrophication) will continue to challenge us in protecting one of our most important natural resources.

Drinking Water

What about your drinking water? The concentration of contaminants in public drinking water systems is strictly controlled by health-based requirements established to minimize risk to human health. These health-based requirements address several areas including surface-water treatment, total coliform bacteria, lead and copper treatment and chemical or radiological contamination. These controls include maximum contaminant levels. A maximum contaminant level protects public health; it is a limit set for a contaminant that cannot be exceeded in the water produced by the water system.

In 1997, 96 percent of the public water systems in Missouri complied with all primary maximum contaminant levels for the entire year. We test for as many as 90 different chemicals on a regular basis. New federal legislation recently enacted enables you to obtain results of this testing. Call your local public water supply or the Missouri Department of Natural Resources at 1-800-361-4827 for more information.

Looking Ahead

For public water systems to treat contaminants, to develop more reliable or better quality sources of water, or to simply maintain their aging infrastructure, they must have a financing source. Congress recognized that many water systems need additional funding to meet the current requirements and the more complex regulations to come. In 1996, it authorized a Drinking Water State Revolving Loan Fund.

Missouri adopted this program in 1998 and has awarded the first loans. The drinking water state revolving fund will provide low-interest loans to community and non-profit, non-community water systems to fund improvements to their water source, treatment or distribution. These improvements will

help the water systems stay in compliance with current and future regulations. The Department of Natural Resources plans to provide more than \$61 million in water system infrastructure loans in 1999.

Air Quality

There currently are 52 air monitoring sites with 125 monitors located in Missouri. They are operated by DNR and the local air monitoring agencies in St. Louis, St. Louis County, Kansas City and Springfield.

Progress Tempered With Concern

Our air quality is improving if we look at the overall trend for carbon monoxide, sulfur oxides, nitric oxide and particulate matter. However, we need to make more progress on attaining lead and ozone standards. Small non-attainment areas for lead exist near lead smelters in Herculaneum, and in the counties of Jefferson and Iron. Approximately 4 million of Missouri's 5 million residents live in the St. Louis and Kansas City areas where the likelihood of ozone formation is greatest. The National Ambient Air Quality Standard of 0.12 parts per million is typically exceeded on hot, sunny summer days. From 1994 to 1998, the St. Louis area had 71 ozone exceedances. During the same period, the Kansas City area had 18 exceedances. The number of days the standard is exceeded in a given year generally corresponds with local weather conditions and the amount of airborne pollution.

Metropolitan Air Issues

We will continue working in the St. Louis area with an enhanced vehicle Inspection/Maintenance Program and the use of reformulated gasoline to lower ozone levels and protect public health. In July 1999, Gov. Mel Carnahan requested from EPA that the Kansas City area be included in the federal reformulated gasoline program.

Looking Ahead

We have seen major progress in our agreements with the charcoal kiln industry, which will prevent the emission of an estimated 100 million pounds of pollutants to Missouri air over the next seven years. In 1998, the department began drafting a rule regulating odors from concentrated animal feeding operations (CAFOs) with 7,000 animal units or more. In March 1999, the Missouri Air Conservation Commission adopted amendments to the odor regulations that apply to the 19 existing Class 1A concentrated animal feeding operations in Missouri. Each Class 1A facility will be required to submit an odor control plan to the department by July 1, 2000, with full implementation of the plan by Jan. 1, 2002. Our goal in each instance is to provide you with better air quality.











Land

In addition to air and water, land is another of Missouri's important natural resources. Reducing erosion, restoring mine land to productive use and properly disposing of hazardous and solid wastes are of increasing importance to protecting our land.

Erosion

In 1982, 141.3 million tons of soil eroded from Missouri's 13 million acres of cultivated cropland. Over the next decade, that number fell by 50

How many animal units are needed to make a CAFO?*

1 ANIMAL UNIT	1 CAFO	1 ANIMAL UNIT	1 CAFO
1.0 Beef cow 	1,000 Animal Units	10 Sheep 	10,000 Animal Units
0.5 Horse 	500 Animal Units	30 Laying hens 	30,000 Animal Units
0.7 Dairy cow 	700 Animal Units	60 Pullets 	60,000 Animal Units
2.5 Swine (weighing over 55 lbs.) 	2,500 Animal Units	55 Turkeys 	55,000 Animal Units
15 Nursery pigs (under 55 lbs.) 	15,000 Animal Units	100 Broiler chickens 	100,000 Animal Units

* Concentrated Animal Feeding Operation

percent: By 1992, about 71.4 million tons of soil eroded from our cultivated cropland, according to the federal Natural Resources Inventory. It is estimated that 54 percent of the soil erosion reduction can be traced to federal, state and local programs targeting highly erodible land. Missouri voters have passed the parks-and-soils sales tax three times in the past 15 years. The tax funds the Missouri state park system and efforts to stop soil erosion, such as conservation practices. This demonstrates a strong commitment to helping us help you protect your natural resources. It also sustains long-range efforts in both areas.

In Special Area Land Treatment (SALT) projects and the larger EARTH projects, landowners in the watershed voluntarily work together to help solve soil erosion and water quality problems. Keeping

soil and agricultural chemicals out of rivers and streams and on the land contributes to agricultural productivity and protects water quality, both of which are vital to Missouri's economy.

Reclaiming Mined Land

Returning mined land to productive use is also a concern when protecting the quality of our natural resources. Of the 170,060 acres of Missouri land disturbed by mining activities, 51,360 acres have been reclaimed or will be reclaimed. New laws require mining companies to restore the land to a productive use and ensure that waste rock deposits remain stable, so they don't contribute to water pollution and wind erosion.

Only abandoned coal mine lands, mined before the reclamation laws were passed, are eligible for federal Abandoned Mine Land cleanup funding. Some lead- and zinc-mined lands may be eligible for cleanup under federal law if they qualify for placement on the Superfund list. Missouri's other abandoned mine land sites, including lead and zinc, barite, limestone, clay, sand and gravel and some other commodities, will remain unreclaimed until either state or federal funding is available.

Solid and Hazardous Waste

The amount of hazardous waste generated per person per year in Missouri declined 139 pounds from 1996 to 1997. We've reduced the amount of solid waste going to landfills by 33 percent. Tire cleanups, both state and owner financed, have removed almost 4 million tires and eliminated 218 illegal waste tire sites in Missouri. Of the 4 million scrap tires generated annually in Missouri, most are now processed into tire-derived fuel, playground material and other useful products. More than 7 million tires remain in illegal dumps in Missouri. We currently are on schedule to clean up half of them by December 2000.

Looking Ahead

Challenges to protect our land are many and varied. The reauthorization of Superfund, a

federal law that provides funding to clean up certain hazardous waste sites, is a significant issue for the Department of Natural Resources.

The trend toward landfill regionalization has closed many smaller landfills, but statewide landfill capacity should remain relatively constant. The department is developing a statewide solid waste management plan to prepare for our solid waste needs in the 21st century.

Preserving our agricultural land resources also is important.

Agricultural land is being continually lost as a result of our current development patterns. More and more people are moving from the core cities to the suburbs and rural areas, resulting in new residential areas, new shopping centers and more highways. Nationally, more than 1 million acres of farmland are lost each year to new highway construction alone.

For More Information

Today, we have high-quality water to drink, clean air to breathe and abundant land resources to enjoy. There are laws protecting your health and your resources from the serious, negative impacts of pollution. And, perhaps most significantly, you are helping us to protect your environment. "Citizen interest and participation in helping us protect the environment is the single, most important thing

we have going for us in Missouri," said DNR Director Mahfood. "Because of them, we have been able to make great progress in the past 25 years in protecting Missouri's water, air and land. We rely on our citizens to let us know their local concerns and their suggestions for improvement," Mahfood added.

If you have questions about the natural resources in your neighborhood or community, or would like a copy of Missouri's State of the Environment report, please contact the Missouri Department of Natural Resources at 1-800-361-4827 or visit DNR on the Internet at [www.dnr.state.mo.us/homednr.htm].

Earl Pabst is environmental policy director for DNR's Division of Environmental Quality. Connie S. Patterson is a Division of Environmental Quality information officer.



Used tires are sorted and stacked prior to being ground up at a recycling facility near Kansas City. Innovative ways of reusing discarded tires turn environmental hazards into valuable resources that benefit Missouri's environment and economy.

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WATER: THE LAST 25 YEARS

During 1999, the Missouri Department of Natural Resources (DNR) continues to celebrate its 25th anniversary. In commemoration, Missouri Resources has been presenting a "retro look" at four areas of environmental interest and importance to Missouri citizens.

Our spring issue addressed air resources in the state. Our summer edition covered land issues. The Fall issue looked at Missouri's energy resources. We complete the anniversary series with this feature on water resources in the state as viewed by our divisions of Environmental Quality, Geology and Land Survey, State Parks, and Energy, as well as the Environmental Improvement and Energy Resources Authority.

Water quality effort has improved

*By Connie S. Patterson and Earl Pabst
Division of Environmental Quality*

Missourians continue to be personally involved in natural resource protection, especially when it comes to water. In 1999, more than 23,000 people are a part of Missouri's Stream Team efforts. Nearly 6,600 agricultural landowners have placed conservation practices on their land. And almost everyone is concerned about the environment in his or her own community and backyard.

A little more than half of Missouri's 21,978 permanent stream miles fully support aquatic life, from pristine streams with native trout to channeled ditches supporting only rough fish. Of the 10,193 stream miles that are impaired, about 200 miles are harmed by chemicals; the remaining 9,993 miles are affected by the physical condition of the stream.

Most of Missouri's 292,204 acres of lakes fully support aquatic life. However, approximately 117,000 lake acres are threatened by eutrophication. Eutrophication is nutrient enrichment of a water body that leads to increased algae growth. About 42,660 lake acres are impaired by herbicides or by discharges from upland dams.

Impacts from point source pollution are decreasing. A wastewater treatment plant or an industrial facility that discharges directly into a stream is a point source. However, impacts from nonpoint source pollution, where there is no single known point of discharge, remain significant.

In September 1998, DNR submitted a list of impaired stream and lake segments to EPA for approval. The approved list contains 178 stream and lake segments that do not meet state water quality standards. DNR is developing a total maximum daily load for each of our impaired waters. This establishes limits on specific

contaminants to restore the water to meet water quality standards. The process to develop and implement the plan to address the cause of each stream and lake segment's impairment, and to ensure that each water body on the list meets water quality standards, could take 10 to 20 years to complete.

The commitment to protecting our water quality is important to Missourians. In 1999, the Missouri legislature approved additional resources for the department to protect Missouri's impaired waters. Work will include sampling at new monitoring sites, providing municipal facility owners with training and assistance and providing technical and financial assistance to the nonpoint source and agricultural communities as needed.

Some control, and none too late

by H. Dwight Weaver

Geological Survey and Resource Assessment Division

"Before the 1980s it was like the Wild West in Missouri with regard to water resources," said James Vandike, a geologist in the department's Geological Survey and Resource Assessment Division (GSRAD). "Everybody was on their own. A person or company could withdraw any amount of water they wanted from a stream or well without reporting it and with total disregard for their neighbor's water needs. Well drillers could install wells without oversight to ensure that they did it properly to protect both the land owner and the cleanliness of the groundwater source."

Jim Williams, state geologist and the director of GSRAD, remembers those years too. "Missouri also didn't have a comprehensive state water plan that met contemporary needs, issues, and concerns about water use and management," he said. "There were no statewide contingency plans for dealing with water shortages; and Missouri wasn't even organized to protect its own water rights where the Missouri and Mississippi rivers are concerned. But all of that has changed for the better in the past 25 years." Williams added.

In 1983, the Major Water Users Law was passed. The department now compiles water-use information. Major water users are defined as those users that are capable of pumping greater than 100,000 gallons per day from either groundwater or surface water. More than 1,800 such users are now registered.

"Water quality and water quantity are not the same everywhere in the state," said Williams. "This is one of the tools we now have for managing the continually increasing demand being made on our water supplies."

The Water Well Drillers Act was passed in 1985. By the fall of 1987, rules were in place establishing minimum construction standards for domestic water wells, to regulate pump installers and to expedite the plugging of abandoned wells, which cause a health and safety risk to us all.

"Because of this law, and the amendment in 1991 that



Severe gully erosion is a prime example of the need to maintain the state's investment in successful soil conservation programs. With more than half the state's 44 million acres devoted to agricultural production, controlling and preventing erosion on Missouri farms helps keep food plentiful and prices reasonable for future generations.

protect water, we must protect the landscape.

To do this, the park system has worked to protect the water already within the boundaries of the parks and to expand parks to protect watersheds. Within the parks, efforts have been made to comply with all environmental regulations and to eliminate any potential for water pollution. Water and wastewater treatment systems and other infrastructure have been improved and underground fuel storage tanks have been removed. Better management of the land itself, such as preventing soil erosion and restoring grasslands, also protects the water as well.

Because water is affected by anything that happens within its watershed, additional land has been purchased adjacent to several state parks to protect stream watersheds. Outstanding streams, such as Pickle Creek at Hawk State Park and First Nicholson Creek at Prairie State Park, are now protected because watersheds have been acquired.

The state park system now boasts 16 Outstanding State Resource Waters, high-quality waters or streams with significant aesthetic, recreational or scientific values that are specifically designated as such by the Clean Water Commission. These streams require special protection against any degradation of quality.

The result of all of these efforts has been that the waters in state parks today serve as benchmarks for a healthy

established the Well Installation Board to oversee administration of the law, we have much better groundwater quality today than we had in 1974," said Williams. "In addition, the Water Resources Law, which was passed in 1989, has set us on the road to a comprehensive up-to-date Missouri State Water Plan. We haven't solved all of our water problems yet but we can usher in the new millennium knowing we've accomplished a lot in water resource management the last quarter of the 20th century."

Parks waters exemplify commitment

by Sue Holst

Division of State Parks

Clear, sparkling water, either in a quiet trickling stream or in a large placid lake, has long been a signature feature of Missouri state parks. When visitors come to state parks, they expect clean water to drink, to swim in, and to just enjoy as an overall part of the state park experience.

Although water has been a vital element since the first state parks were established in the 1920s, a growing awareness of the need to protect it has developed in the last 25 years. This has been coupled with a clear understanding that what happens to the land affects the water as well, and that to

environment. They not only provide habitat for aquatic life, but also provide safe and enjoyable recreational opportunities for more than 17 million state park visitors each year.

Clean water for companies and communities

by Kenneth Seeney

Environmental Improvement and Energy Resources Authority (EIERA)

In 1975, the governor noted in an annual report "clean water is a matter of concern to every Missourian; however, the responsibility falls directly on a few."

Established in 1972, the Missouri Environmental Improvement Authority (EIA) was mandated with the responsibility to protect Missouri's waters. In 1983, state lawmakers added several responsibilities and the EIA became the Environmental Improvement and Energy Resources Authority (EIERA). Also, lawmakers transferred the EIERA to the Department of Natural Resources (DNR).

Initially, the EIA focused on Missouri industry, providing assistance for construction of wastewater treatment facilities. While there was some criticism of the EIA for assisting industry, legislators and state leaders felt that industry needed assistance to control pollution and thereby comply with state and federal laws.

"In the early 1970s, it's quite possible that industry did not realize the impact its manufacturing processes had on the environment," said Avis Parman, chairman of the EIERA since 1997. "But through our low-cost financing programs, industry officials were encouraged to address wastewater discharge and water quality problems," she added.

From 1973 to 1976, the EIA provided more than \$82 million in low-cost financing, most often to assist Missouri industry.

In 1982, the EIA developed an initiative called the Grant Anticipation Note (GAN) Program. From 1985 to 1989, the GAN program provided \$170 million in low-cost loans to 100 Missouri communities for wastewater treatment projects.

In 1987, noting that the termination of the GAN program was forthcoming, the EIERA board showed tremendous vision and, in cooperation with DNR, the Clean Water Commission, and the U.S. Environmental Protection Agency, initiated a three-year development process. In 1990, the first bonds were issued through the State Revolving Fund (SRF) for sewage and wastewater treatment projects. Since 1990, the SRF has provided more than \$750 million in low-cost financing to 75 Missouri communities.

"This was a great program ... somewhat challenging in its development stages, but it's still one of the top five SRF programs in the nation," said Bill Clark former chairman of the EIERA (1987-1991) and president of the Kansas City Urban League.

Last year, the SRF was expanded to include bond financing for public drinking water systems.

Fossil fuel use still affects water quality

by Jim Muench
Energy Center

As it did 25 years ago, our reliance on fossil fuels continues to increase. Energy production, transportation and use affect all aspects of our environment, including water. Decreasing energy use, while increasing the use of alternative motor fuels and renewable energy, helps reduce damage to our lakes and waterways.

Oil spills and leaks from trucks and pipelines, oil residue from parked vehicles, and petroleum-based asphalt and chemical fertilizers all pollute our water. Sulfur dioxide emissions from vehicles and electric power plants causes acid rain that falls on our lakes and waterways. Habitats can be harmed both by power plant mercury emissions and by water from the plants if it is insufficiently cooled before it returns to the river.

Over the past 20 years, the Energy Center has worked to stem water pollution by supporting energy efficiency and alternative-energy projects. We currently help fund Ridesharing and Clean Cities programs in St. Louis and Kansas City, which promote the use of cleaner fuel technologies, to cut harmful emissions and reduce our reliance on fossil fuels.

Recently, we helped secure the first wind power project in Missouri, available as an alternative to conventional electric power, to some customers in Kansas City.

In the future, waterways themselves may provide an environmentally acceptable source of renewable energy through micro-hydropower technology that uses small turbines driven by a river's normal rate of flow.

We also have supported projects that employ energy-efficient ways to clean up sources of water pollution. One project, later adopted by other communities, helped the town of Bethel create wetlands to treat wastewater, saving the energy and construction costs of a mechanical waste treatment center and lessening stress on the environment.

The Energy Center also is working to inform businesses about new, cleaner technologies; to develop new approaches to help more schools and local governments afford energy-efficiency projects and buy vehicles that burn cleaner alternative fuels; to accelerate energy-efficiency improvements in state-



Missouri has earned a reputation as a national leader in soil conservation. Terracing is an effective practice that has helped to reverse soil erosion.

owned buildings; and to propose new incentives for Missouri citizens and businesses to practice energy efficiency and use renewable energy whenever possible.

When you save energy, you reduce environmental damage and save money - a winning combination for Missouri citizens, businesses and water quality.

As DNR's 25th anniversary ends, a new millennium is beginning for the planet - and its environment. We hope you have enjoyed our look back in 1999, and join us as we look forward to the next 25 years.